808

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Abstract: This paper reports on two planar helical slow-wave structures that offer wide bandwidth and a good potential for microfabrication. The paper begins with a review of progress made in recent years in the development of a planar helix slow-wave structure with straight-edge connections (PH-SEC). This is followed by new results that compare the performance of the PH-SEC with that of the circular and rectangular tape helices; specially considered is the interaction impedance for the forward- and backward-wave. The focus of the rest and the major part of the paper is a new slow-wave structure, namely, the rectangular ring-bar with straight-edge connections (RRB-SEC). It is shown that, similar to the case of the circular ring-bar structure, the RRB-SEC enhances the interaction impedance for the fundamental forward-wave while reducing the interaction impedance for the backward-wave. Detailed results for phase velocity and interaction impedance of the RRB-SEC are presented to show the effect of structure dimensions. Two configurations which are suitable for microfabrication of the RRB-SEC on a silicon wafer are also presented. As a proof-of-concept, one of these configurations, designed for operation at W-band, is microfabricated. The fabricated structures include a coplanar waveguide feed. On-wafer cold-test S-parameter measurements are reported for frequencies from 80 to 110 GHz. The measured results match well with the simulation results when the effect of surface roughness of the different parts of the fabricated structures is accounted for in the simulations. The RRB-SEC, with rectangular or square cross section, has potential application in high frequency travelling-wave tubes that aim to achieve high power operation.

Keywords: Electron devices, Interaction impedance, Phase velocity, Planar helix, Ring-bar, Slow-wave structure, Traveling-wave tube.